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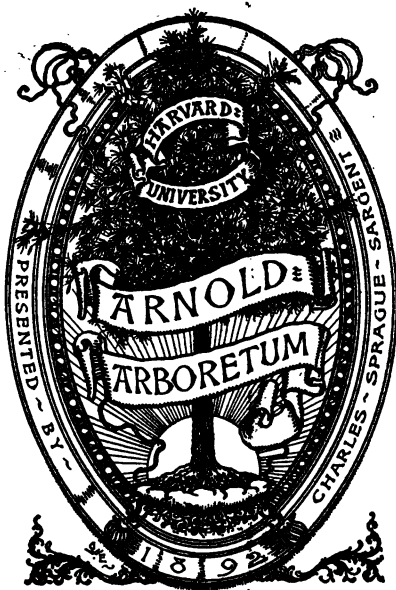
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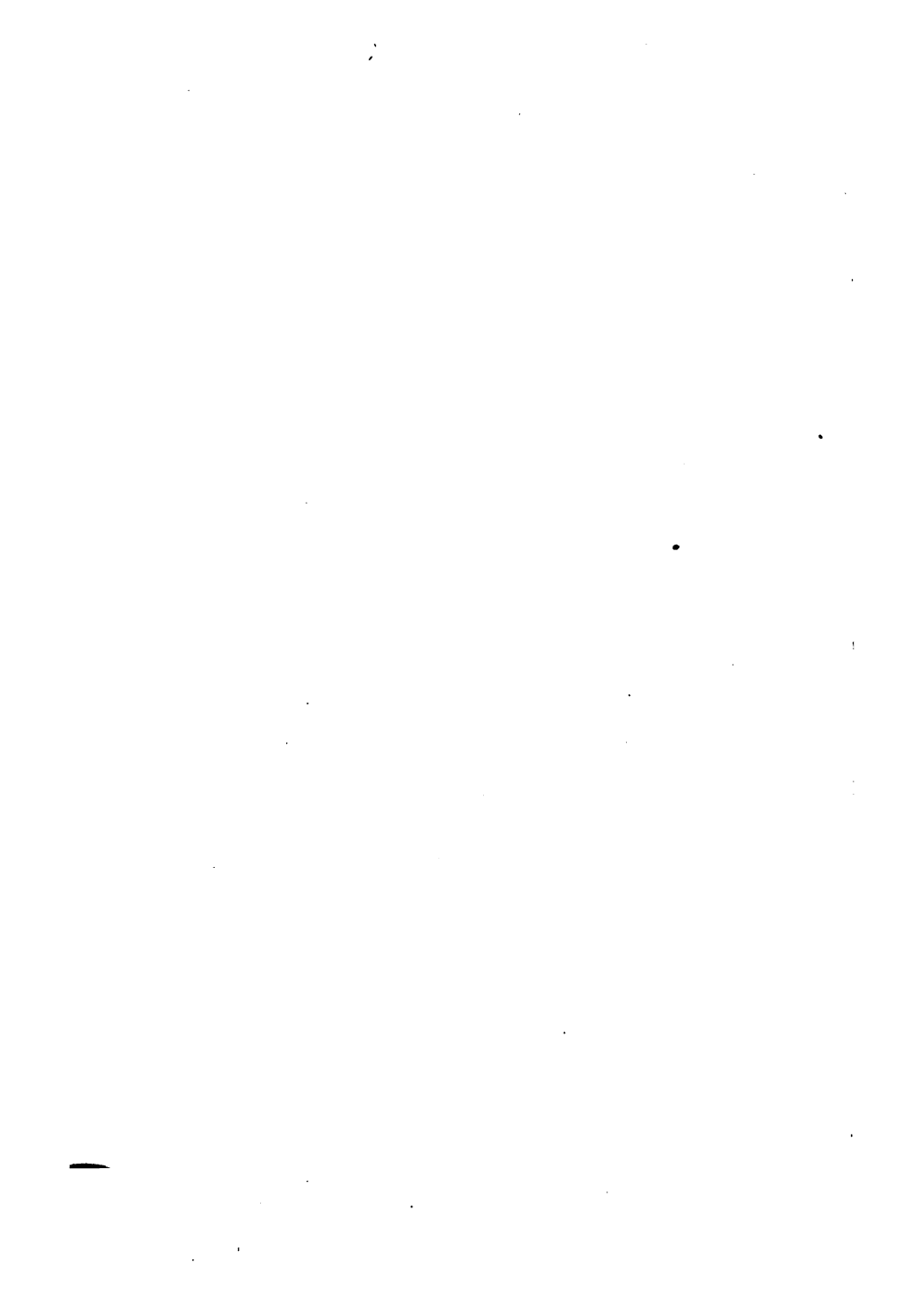
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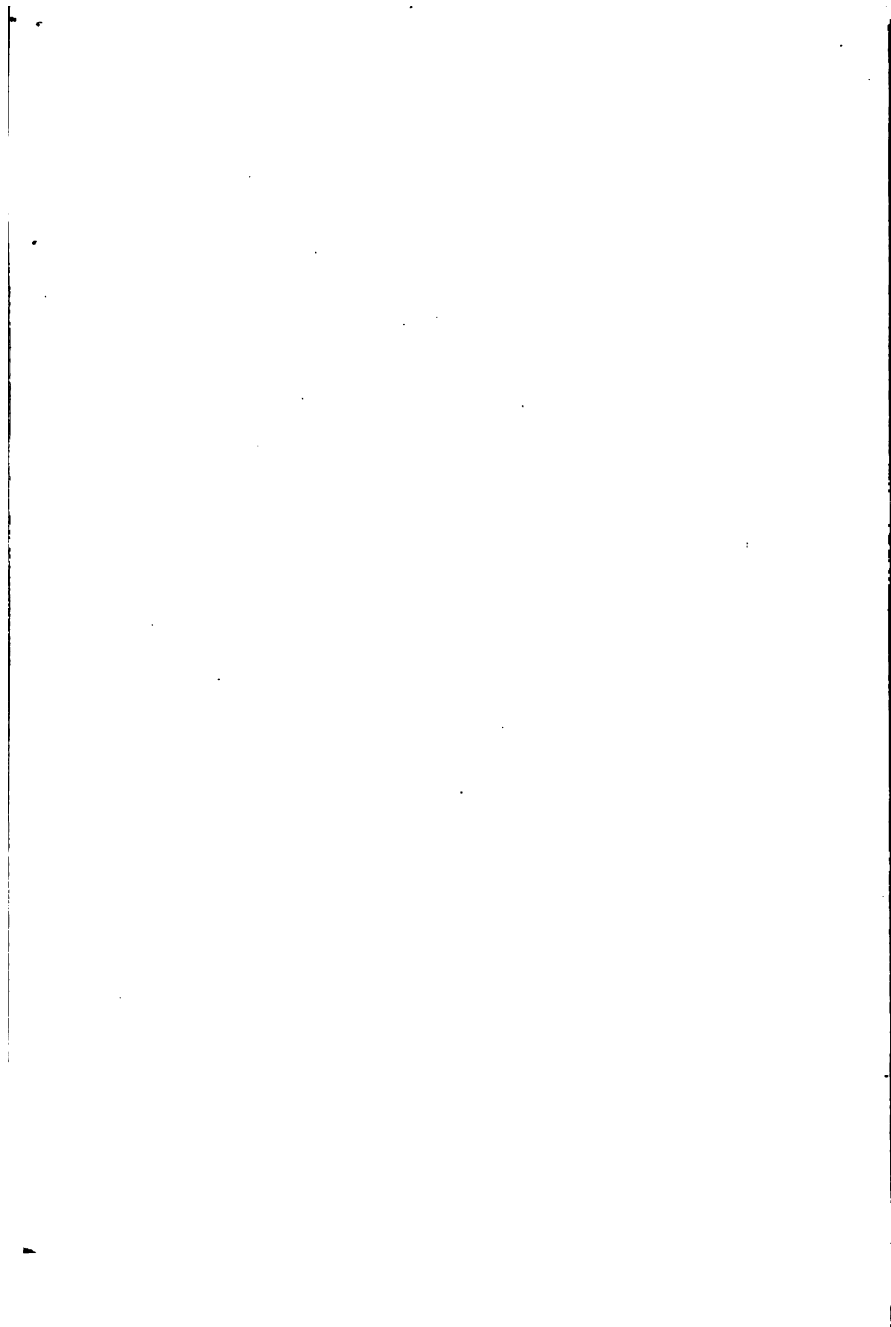
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THE ESTATE NURSERY



THE ESTATE NURSERY

A HANDY BOOK
FOR OWNERS, AGENTS, AND WOODMEN
ON THE

Propagation and Rearing of Forest Trees

FOR PLANTING ON PRIVATE ESTATES

Adapted to the New Forestry System

BY

JOHN SIMPSON

PREMIER MEDALLIST OF THE SOCIÉTÉ NATIONALE D'ACCLIMATION
DE FRANCE; AUTHOR OF 'THE NEW FORESTRY' 'QUICK FRUIT CULTURE'
'REPORT ON HORTICULTURE' (FRUIT AND VEGETABLE DIVISION)
IN "THE SOCIETY OF ARTS ARTIZAN REPORTS ON THE PARIS UNIVERSAL
EXHIBITION OF 1878"; 'THE WILD RABBIT AND RABBIT WARRENS' ETC.

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1905

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TO OWNERS OF WOODS

The Author of 'The New Forestry' and 'Estate Nursery' begs to state, in consequence of the inquiries he constantly receives from owners of woods, that he advises on all subjects connected with woods and game preserves.

He inspects woods separately, takes stock of their contents, condition, and value; reports fully, sets out timber for sale, arranges planting operations, makes out lists and estimates, directs labour, and, when engaged by the year, overlooks the whole work of the woods. Terms moderate, according to distance.

He has for a considerable time been engaged in reorganising the woods on a number of estates throughout Great Britain, his acquaintance with woods and game preservation in nearly every county, and knowledge of Continental and British forestry, enabling him to advise under a great variety of conditions, so as to avoid the mistakes of the past and secure better crops of timber in the future.

When personal inspection is not desired, he advises by letter if particulars regarding soil, climate, and situation are furnished.

List of some of those Noblemen and Gentlemen by whom the Author has had the honour of being consulted, or whose woods he supervises.

His Grace The DUKE OF NORTHUMBERLAND.
 The Most Honourable The MARQUIS OF NORMANBY, Mulgrave Castle.
 The Most Honourable The MARQUIS OF AILSA, Culzean Castle, Ayr.
 The Right Honourable The EARL OF WHARNCLIFFE, Wortley Hall.
 The Right Honourable The EARL OF LISBURN, Crosswood, Aberystwith.
 The Right Honourable LORD MONTAGU, Beaulieu Palace, Southampton.
 The Right Honourable LORD CASTLETON, Ireland.
 LADY CHERMSIDE, Newstead Abbey, Notts.
 SIR EDWARD GREEN, Ken Hill, Norfolk.
 SIR HENRY HOARE, Stourhead, Bath.
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 Colonel J. GORDON MATTLAND, Cairn Edward, Galloway.
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 R. CHADWICK, Esq., Findhorn House, Forres, N.B.
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 W. F. PEPPER, Esq., Shipton Court, Oxford.
 HUGH MORRISON, Esq., Fonhill, Wilts.
 PETER HOARE, Esq., Luscombe Castle, Devon.
 Honourable Company of Edinburgh Golfers, New Club, Edinburgh,
 and many others.

THE ESTATE FOREST TREE NURSERY

SECTION I

OBJECTS AND ADVANTAGES

FREQUENT inquiries from owners of private estates for more minute practical directions than are usually given in forestry books on the subject of propagating and preparing young forest trees for forming plantations have suggested this book, the object of which is to point out the great advantages, economical and otherwise, of raising forest trees from seed, or from very

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young seedlings, in the estate nursery which has become indispensable as an adjunct to the woods wherever it is desired to carry on regular and successful planting and keep initial expenses within reasonable limits.

A glance at Table II, on page 25, on present prices of young trees from public nurseries, will show that, even on the thin planting system of the past, the cost of plants *alone* is going to equal, and in the case of some of the most useful species much exceed, the figure that used to be paid for fencing, draining, pitting, planting, and trees complete; while, if the dense Continental system of planting is adopted, as it should be, involving at least from 3,000 to 5,000 trees to the acre, according to species and elevation, the cost will be raised to a figure likely to cripple extensive planting or

stop it altogether. Yet we believe, and propose to show, that by raising the trees from seed, or one-year seedlings, in the estate nursery, the cost of planting may be kept down to a figure hardly exceeding the lowest recorded. In Brown's 'Forester,' 1882, pp. 505, 506, the average cost per acre (the highest and lowest he ever paid), on his thin system, at the rate of from 1,800 to 2,400 plants, was £6 11s., and included fencing, pitting, draining, trees, and planting. A reference to Table I, p. 21, will, however, show that, with home-raised trees and much thicker planting, Brown's figure need not yet be much exceeded, if exceeded at all. Contrast this table with nursery prices at the present time, which will show that the cost per acre for purchased trees, for pure crops, of such useful species as the Scots fir, common larch, Corsican fir, Japanese larch, and Douglas

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fir, on the dense system of planting, may amount to from £7 10s. to £25 for trees *only* of planting size—a sum, in principal and interest, sufficient to paralyse planting at the outset. The prices for trees have risen to the above figures within the past few years, or since there has been a revival of interest in forestry and a greater demand for trees, and to all appearance they may be expected to continue high.

The estate, or home nursery, proposed and described in the following pages, has little in common with what has hitherto passed under that name on private estates, and which has usually stood in the same relation to the woods and gardens that the lumber room has done to the mansion, only that it has contained anything but what it ought to have contained. Except on a few estates,

in most cases where nurseries have been made lately, an extensive acquaintance with woods all over the country leaves us ignorant of a single example of a private forest tree nursery on a working plan, stocked with the kinds, quantities, and proportions of trees required to meet the planting demands of the estate. There are few estates of any considerable size without what goes by the name of 'the nursery,' but it is seldom planned to supply the woods, and it is a fact, proved by estate records and common experience, that on most big estates the forest trees required for forming new plantations and making up old ones have not been raised at home, but have all, or nearly all, been bought at high prices from distant public nurseries, and that the losses after planting such trees have often been great.

As a rule, existing home nurseries are

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far too expensively laid out, too often encumbered with perfectly needless fences, cut up with useless walks and paths, involving much profitless labour and expense, and far too often the ground is filled with surplus garden stock, or converted into a flower and vegetable garden for the use of the forester. Forest trees, if any, are often neglected until they become too old and large, and thickets of these, that would be better burned or consigned to the rubbish heap, may often be seen occupying good ground that might have been stocked with young forest trees, over and over again, to supply the woods. What a contrast such a nursery presents to a German nursery in the State forests ! often only an extemporised enclosure fenced round with a few spruce rails to keep out deer and vermin, but stocked to its fullest capacity with the

trees required. Owners will, in future, have to raise their own forest trees as their gardeners have always raised the garden stock. The propagating of forest trees from seed does not involve a tithe of the trouble that the gardener has every year in getting up his 'bedding-out stuff' and other garden stock, and from experience we are perfectly sure that any good gardener might add the forest tree nursery to his charge without inconvenience where the forester did not understand such work. The number of species of timber trees required are so few, and the raising of them from seed to the planting-out stage is such a simple business, that one wonders owners and foresters have not long ago systematically adopted the plan of raising their own trees in their own nurseries. Apart from enormously reduced cost, the percentage

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of failures in home-raised trees is fractional compared to losses in purchased trees, which has not infrequently reached 50 per cent. or more, from causes well known to foresters.

So far as we know, there is no book of this kind in print at present, and certainly none adapted to the new system of forestry. The nursery is noticed more or less in books on forestry, but usually in an abridged form. Here we have tried to give such simple directions as can be easily understood and readily followed, and we have drawn largely from our own experience, as a gardener and forester, in the propagation of a far greater number of trees and plants than usually falls to the lot of the forester alone, and have suggested what we believe to be the best methods to adopt in private nurseries.

SECTION II

COMPARATIVE COST OF HOME-RAISED AND PURCHASED TREES

WHILE considering the interests of planters, nothing said in these pages need be regarded as reflecting on respectable nurserymen. Their prices of trees are not regulated by the actual cost of production, but by the demand and other causes; for, except in the price of seed, one species can be raised just as cheaply as another, and, in any case, the estate nurseryman may be sure that, with the facilities at his disposal, he can, if he chooses, raise all kinds of forest trees of the best quality at a cost far below trade

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prices. There are, however, nurserymen and nurserymen, and it is well known that only the biggest firms can execute large orders from their own stock, and *they* have sometimes to buy second-hand. There are, however, 'local' nurserymen, so called, who undertake large planting contracts, who have next to no stock of their own, nor anywhere to put a large stock if they had it. The whole, or nearly the whole, of their orders are supplied second-hand without the knowledge of purchasers, and the delay in their execution is often the cause of failure, while the trees supplied are generally of second-rate quality. One example, of many known to the writer, may suffice. A gentleman, in order to have trees from a soil and locality the same as his own, contracted with a nurseryman, not far distant, who undertook

to supply the order from his own nursery. As soon as the order was placed—the purchaser depending on the vendor's good faith—an advertisement appeared in a trade circular, from the nurseryman, inquiring for the very kinds, quantities, and sizes of trees he had contracted to supply, and a quiet visit to his place disclosed the fact that his whole stock of forest trees would not have supplied a tenth part of the order. It is undoubtedly a great advantage, when trees have to be bought, to get them near by, if possible ; but the chances are that the order will be executed from a distant nursery. We have known an order given to a local nurseryman in the south of England, and all the trees come from Scotland ! The best plan is to deal with big firms, who make forest trees a speciality and keep large stocks on hand ; but, unfortunately,

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such firms are extremely few, and they have to supply not only private estates but the trade as well. We can only advise purchasers to receive no second-hand lots, and to get quotations not by the thousand but for the total number wanted. Nurserymen are always willing to quote on these lines.

The two following tables, given in this section, will give the reader a good idea of the difference between the cost of home-raised and purchased trees. The figures and information given in No. I table are based on the author's own experience, or are collected from the most reliable sources, and are not exaggerated. The prices of tree seeds are from a well-known English firm, which guarantees the best quality. Tree seeds are rarely quoted in British catalogues. Attention is drawn more particularly to the number

of seeds in a pound, the price of the seed, the percentage expected to grow, sizes of the two-year seedlings; and, if the very small cost of labour, tending, and rent of the seed bed is added, the cost of raising the trees per 1,000 to the planting-out stage may be easily calculated. Practically, the price of the seed and percentage that germinate are the only conditions that make much difference between the cost of the trees of any of the kinds after they come up. It should be borne in mind also that two-year untransplanted seedlings, of both firs and hardwoods, are often tall enough for planting out at once from the seed bed, to form plantations, where bracken and very rough herbage have not to be contended with, and have straight roots in the best condition for moving, requiring only small holes. Indeed, the

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Douglas fir and larch might almost be dibbled in in some soils, or let in with a small spade.

Two-year seedlings of Douglas fir and larch are often from 9 to 12 inches high, and oak, ash, and sycamore 12 to 18 inches. Pines, like the Scotch and Corsican fir, grow slower than larch, and beech slower than ash; but all may be, and often are, planted from the seed bed the second year, and under equal conditions succeed better than older transplants. A very good example of seedling planting is afforded by the plantations formed, on the waste cinder hills in the mining districts of Cornwall, by E. Beauchamp Beauchamp, Esq., of Trevince. About 100 acres were planted in 1864 with Scotch fir, larch, Austrian fir and *Pinus Insignis*, both seedlings and transplants.

Comparative Cost of Trees 21

TABLE I

Giving Kinds, Costs, Quantities, Time, Depth to sow, and other particulars in the Estate Nursery.

Kinds	No. seeds in 1 lb. approximately	Price per lb. ¹ 1905	No. of seeds that may be expected to grow	Season to sow	Depth to sow. In furrows not exceeding	How thick to sow	Width between rows	Height of 3-year seedlings
Douglas Fir	100,000	s. d. 30 0	Per cent. 70	April	Inch $\frac{3}{4}$	Seeds 80 to 100 to yard run	Inches 9	Inches 4 to 9
Japanese Larch	70,000	15 0	30	April	$\frac{3}{4}$	200 to yard run	9	6 to 10
Common Larch	70,000	2 6	30	April	$\frac{3}{4}$	200 to yard run	9	6 to 10
Scots Fir	60,000 to 70,000	3 6	65	April	$\frac{3}{4}$	150 to yard run	9	6
Corsican Fir	70,000	4 0	65	April	$\frac{3}{4}$	150 to yard run	9	6
Austrian Fir	60,000	6 6	65	April	$\frac{3}{4}$	150 to yard run	9	5
Maritime Pine	60,000	1 0	70	April	$\frac{3}{4}$	150 to yard run	9	6
Silver Fir	10,000	2 0	45	April	$\frac{3}{4}$	100 to yard run	6	3 to 5
Norway Spruce	60,000	1 3	65	April	$\frac{3}{4}$	150 to yard run	6	2 to 5
Weymouth Pine	40,000	10 6	40	April	$\frac{3}{4}$	200 to yard run	6	—
Hemlock Spruce	—	30 0	—	April	$\frac{3}{4}$	200 to yard run	6	—
Sycamore.	5,000	0 8	70	As soon as ripe	1	100 to yard run	12	12 to 18
Ash . .	7,000	0 6	70	As soon as ripe	1	100 to yard run	12	12 to 18
Common Alder	250,000	0 9	25	As soon as ripe	$\frac{1}{2}$	Very thick	6	12 to 15
Birch .	500,000	0 4	20	As soon as ripe	$\frac{1}{2}$	Very thick	6	6 to 15
Elm . .	60,000	—	40	As soon as ripe	$\frac{1}{2}$	—	7	3

¹ The Country Gentlemen's Association, Limited, 2 Waterloo Place, Pall Mall, S.W., supplies tree seeds of the very best quality at the prices named in this column.

Only the most useful forest trees are given in this table, but the directions have a general application.

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being used; but the trees taken from the seed bed started to grow sooner, and a smaller percentage of them died than of those that had been previously transplanted, and which, no doubt, cost more. These trees, we are told, now afford splendid covert and shelter, and are from 40 to 45 feet high, growing in what was 'literally a howling wilderness' ('Gardener's Chronicle,' January 28, 1905).

Authorities differ widely as to the percentage of seed expected to germinate, no doubt because of the varying quality of the seed; but many tree seeds fail from sowing too deep, or too shallow, or in a wet soil; and many seeds are eaten by birds and vermin from not being properly red-leaded before sowing.

Oak, sweet chestnut, and beech are

sold cheap by the bushel, and may often be collected on the estate. The two first may be sown from $1\frac{1}{2}$ to 2 inches deep, and the beech 1 inch in rows 12 inches apart. Ash or sycamore seeds are produced plentifully on estates, are easily gathered, and usually good.

The number of seeds per pound, and the number expected to germinate, as given in the foregoing table, are near enough for practical purposes ; but both vary considerably, according to the quality of the seed, and there is no very accurate data on the subject. Native Scotch fir seed is generally good, but Scotch larch seed is far inferior to Continental seed, if the experience of Scotch foresters is to be relied on. Conifera seeds generally come from Hamburg and Erfurt in Germany, and, judging from the proportions that usually grow in public nurseries, the seed

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must be of fair quality. Ash and sycamore seed are sometimes mixed with mould or sand till the seeds are freed, but they are better sown as they fall from the tree in autumn. So also should birch and alder. When the seeds of forest trees have to be stored, the situation should be cool and dry to prevent fermentation or premature vegetation.

The next table, No. II, showing the prices of forest trees as supplied from public nurseries, is given to show the difference between the cost of home-raised and purchased trees, not forgetting the fact that a much less percentage of home-raised trees fail after planting. The prices are average ones, taken from several of the best-known nurserymen's catalogues, and the kinds are given in nearly the same order as the first table. The quotations are per 1,000,

but reductions are sometimes allowed on larger orders.

TABLE II

*Prices of Young Forest Trees in Public Nurseries,
from British Catalogues, 1904-5.*

Douglas Fir :

1-yr. seedlings	20s. to 21s.	per 1,000
2-yr., not transplanted . .	35s.	" "
1-yr., 1 yr. transplanted . .	45s. to 50s.	" "
6 to 12 ins., transplanted . .	50s. to 65s.	" "
12 to 24 ins., transplanted	100s. to 120s.	" "

Japanese Larch :

1-yr. seedlings	15s. to 20s.	per 1,000
2-yr. seedlings from seed bed	30s.	" "
1-yr., 1 yr. transplanted . .	45s. to 65s.	" "
12 to 18 ins., transplanted	100s. to 150s.	" "

Common Larch :

1-yr. seedlings	2s. 6d. to 5s. 6d.	per 1,000
2-yr. seedlings	15s.	" "
1-yr., 1 yr. transplanted . .	17s. 6d. to 20s.	" "
2-yr., 2 yrs. transplanted . .	45s. to 50s.	" "

Scots Fir :

1-yr. seedlings	3s. 6d. to 5s.	per 1,000
2-yr. seedlings	10s. 6d.	" "
12 to 24 ins., transplanted	25s. to 35s.	" "
2 to 3 ft.	50s.	" "

¹ The Country Gentlemen's Association, Limited, 2 Waterloo Place, Pall Mall, S.W., supplies young forest trees from all the leading growers.

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Corsican Fir :

1-yr. seedlings	3 <i>s.</i> 6 <i>d.</i> to 5 <i>s.</i>	per 1,000
2-yr. seedlings, not trans- planted	5 <i>s.</i> to 7 <i>s.</i> 6 <i>d.</i>	" "
6 to 24 ins., transplanted .	35 <i>s.</i> to 80 <i>s.</i>	" "

Oak :

1-yr. seedlings	6 <i>s.</i>	per 1,000
2-yr. seedlings	10 <i>s.</i> 6 <i>d.</i> to 12 <i>s.</i> 6 <i>d.</i>	" "
9 to 24 ins., transplanted .	35 <i>s.</i> to 40 <i>s.</i>	" "

Ash :

1-yr. seedlings	3 <i>s.</i> 6 <i>d.</i> to 5 <i>s.</i>	per 1,000
2-yr. seedlings	7 <i>s.</i> 6 <i>d.</i>	" "
2 to 3 ft., about 3 yrs. old, transplanted	30 <i>s.</i>	" "

Sycamore :

1-yr. seedlings	5 <i>s.</i>	per 1,000
2-yr. seedlings	7 <i>s.</i> 6 <i>d.</i>	" "
1 to 3 ft., transplanted .	20 <i>s.</i> to 30 <i>s.</i>	" "

Beech :

1-yr. seedlings	4 <i>s.</i> to 5 <i>s.</i>	per 1,000
2-yr. seedlings	7 <i>s.</i> 6 <i>d.</i>	" "
12 to 24 ins.	20 <i>s.</i> to 30 <i>s.</i>	" "

The foregoing list need not be extended, as it represents about the highest, lowest, and intermediate prices and sizes of forest trees generally planted.

An approximate practical idea of the difference between trade and home nursery prices is afforded by the Japanese larch, for example. The seed is one of the most expensive (15s. per pound), but is soon likely to cost less, and produces the lowest percentage of plants per 1,000 among firs; but from 15s. worth of seed nearly 20,000 healthy seedlings may be expected between April and October, on a very small plot of ground, and the seedlings may remain in the seed bed for at least two years, when many will be fit for planting out in the woods finally; or about 2s. 6d. per 1,000 would transplant them, if transplanting was desired. Add the labour of tending for the time—a very small sum—and you have the cost of home-raised trees fit to plant out in the wood. The trade price for

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one- and two-year seedlings is from 15s. to 30s. per 1,000.

Seed of common larch, and some other firs, costs from 2s. 6d. to 3s. 6d. per pound ; the same proportion of seedlings, or more, may be expected the first year ; and as the seedlings can be bought at from 2s. 6d. to 3s. 6d. per 1,000, which sum includes all nursery expenses and profits, it will be seen that the cost of labour and tending is not much, and that the price of the seed and demand are the ruling factors.

SECTION III

SITUATION OF THE NURSERY—SOIL— MANURE—WATER SUPPLY

As will be seen, when we come to the subject of extent and arrangements, the home 'nursery' of the past has been too much associated with the idea of coddling and shelter; but the nursery contemplated here is simply an enclosure devoted to the propagation and preparation of forest trees for planting out in all kinds of exposed situations. No kinds of agriculture or garden crops are exposed to such vicissitudes of weather and exposure as young forest trees are when newly transferred from the shelter of the

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nursery to open plain or bleak mountain-side; for no matter how well they have been prepared and hardened off, the change tests the endurance of the trees severely. To reduce this risk and prevent failures, the situation of the nursery should be open and somewhat elevated to reduce the risk of late frosts; low, misty spots are to be avoided. It should be convenient to the woods, and some shelter is required from the north and north-east, not for the sake of protection to the established trees generally, but to enable the work of transplanting very young and tender seedlings to be carried on in dry spring weather when the winds are often cutting. A wood or plantation on the north and east aspect, and not too distant, would be sufficient. Otherwise the situation should be open. We have seen all the usual forest trees

raised successfully, at a high elevation, in the north of England, though exposed to both north and east winds. More damage is to be feared from a warm, sheltered nursery than an exposed one. The garden nursery is the place for exotics and all tender subjects.

Soil.—The kind of soil is important. If it is one foot deep it will do, and the depth need not exceed 15 inches. Short, fibrous, and not long roots are wanted on young trees. A deeper soil than the above is recommended by both British and Continental authorities, and deep trenching to secure it; but a depth of more than 15 inches is not required, if it is not a positive evil. The roots of young forest trees dive deep, if they can get down, making long tap roots, instead of fibres, and which have to be cut off short at every transplanting.

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It is rarely that young forest trees from a nursery have roots more than six or nine inches long, even at the final stage. Far more depends on the texture and quality of the soil than on its depth. Surface mulching is better than trenching, as it helps to secure those short bunchy roots that insure successful transplanting. If the ground is naturally well drained, all the better; and if it is wet, it should be drained in the same way as agricultural land is drained. Whether sand or loam, it should pulverise readily and turn up fine and powdery to the spade in dry weather. Not that forest trees will not thrive in stiff, heavy soils, but because sowing and transplanting are far more easily and successfully carried out in a fine soil.

One of the best little nurseries we ever knew was fenced in from a pasture field,

and dug deeply over with a full-sized Scotch spade in October, the work taking about a fortnight. By spring the frost had pulverised the soil, the buried sod was dead, and in April following about 200,000 young trees of different sizes and kinds were successfully planted as the first stock, and the plantations from that nursery now testify to the value of a home nursery in a remarkable manner.

Manuring.—Deep trenching, heavy manuring, and cropping previously with some agricultural crops has been often recommended in preparing a nursery, but the plan loses time, is expensive, and seldom or never needful. If the ground is very poor, and needs lime, we should apply the last in conjunction with rough leaf mould or vegetable refuse ; but when the ground is pasture, or fair agricultural land, no manure will be needed, for trees,

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for several years. Forest trees require little manure because most of their food comes out of the atmosphere and comparatively little out of the soil. On no subject is it more needful to disabuse the minds of foresters than on this, for the supposition that forest trees needed to be manured, like agricultural and garden crops, grown for their fruits or seeds, has caused much needless expense and labour in manuring nurseries. Impoverishment is quite possible in time; but if the record of some nurseries was published, showing the repeated stocks of young trees that had been taken out of them for a long period without any manure worth mentioning, it would surprise many foresters. When manure is wanted, rough leaf mould from the woods, or any half-rotten vegetable refuse will supply all wants for a long period. There are

usually plenty of such materials for the fetching on estates, and if the leaf mould is put down on the vacant quarters and dug in when they are planted, it will be sufficient. On heavy soils, sand and leaf mould can hardly be supplied in too great quantities. We know of no manure that is a greater producer of fibrous roots than common leaf mould, and a nursery need never run down where it can be had. We never used anything else, and when carts were loaded out to the woods they always came back with leaf mould. Tons of it can usually be raked together in any wood in a few hours, and it may lie till needed. Another way of enriching the soil, when leaf mould is scarce, is to take a manured crop of potatoes off vacant quarters now and then. This crop breaks the soil up, and is off by the time tree-planting begins. Kainite has

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also been used with success with young larch.

Water supply.—A good handy supply of water run into convenient open cisterns should be provided in all nurseries, and the supply pipe should enter the cistern at the bottom underneath to prevent it being frozen.

SECTION IV

PLAN OF NURSERY—SIZE AND
STOCKING

Plan.—A good and economically managed estate nursery lies at the very threshold of any working plan of forestry, and we state this because hitherto home nurseries have been planned and laid out on the most extravagant lines, and attention is called to the fact here to show where economy can be effected.

In one of the most recent and pretentious British works on forestry, revised and brought up to date, the old and extravagant plan of a home nursery, with all its faults, is retained, and the

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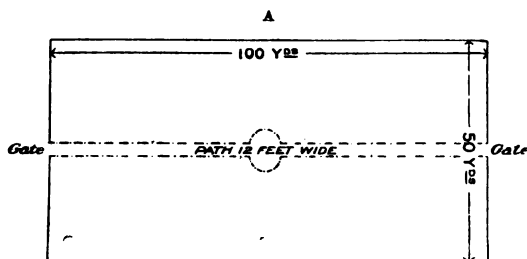
directions given, for an estate of any considerable size, show a nursery with over two miles of carefully planted hedges, round the various quarters, on the coddling principle, involving much annual trimming; and not far short of two miles of roads, 12 and 5 feet wide respectively, all to be excavated and laid down between the hedges on solid road-metal foundations, macadamised or gravelled on the surface, and kept like a garden. The cost of forming the roads and hedges alone, on such a scale, whether the nursery is large or small, and their up-keep, is enormous, and such adjuncts are wholly useless, and are usually quite dispensed with in public nurseries. Another reason for making private nurseries on a simple, inexpensive scale is the fact that on many estates a nursery may not be needed permanently on a

large scale. It is now realised by owners of estates, that if it is profitable to plant their waste lands at all, the sooner they are planted the better, and some owners are planting on this principle on a scale that will not need to be continued beyond a certain time, hence a large permanent nursery will not be necessary. There are many estates on which, if all the plantable land was once stocked, equivalents, in planting, for fellings only, would be required, and the largest periodical clearings would not require a large nursery to hold a sufficient stock of young trees to fill them up again. In the dense, properly managed woods of the future a very much smaller acreage will need to be cleared than has to be cleared now, in our thin woods, to produce a fall of timber for sale because the crop will be heavier.

In shape the nursery should take

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that of a square or parallelogram. The following diagram represents a parallelogram-shaped nursery like several now in



PLAN OF HOME NURSERY

successful working order, and laid out at very little expense.

The diagram shows an enclosure 100 yards long and 50 yards wide, or a little over one acre, with one 12-foot path up the middle on the natural undisturbed ground or grass, and a gate at each end, leaving an unbroken strip on each side 23 yards wide. If the enclosure was as large again there

might be two paths, for convenience, dividing the ground into three strips, with a communicating cross-road at A. There are no walks nor sub-divisions. The parallel strips represent cropping ground from end to end, to be dug and filled with rows of trees or beds as wanted, with temporary alleys where required, the same as gardeners have between their crops. Fanciful permanent divisions for lots of different sorts and ages are impracticable in a fully-stocked nursery. The best plan is to fill up vacancies, as the London market gardeners do, with the first crop that is ready. It is the number of trees and the proportions of each kind needed that should be studied, and it does not matter how the lots are mixed so long as they are there and kept distinct. There is seldom a cart in a nursery with a load above a few hundred-

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weights, and most of the carrying is done in wheelbarrows. The hard grass path, made firm by a few cinders rolled into it, is all that is wanted or attempted where expense and utility are considered. Hundreds of pounds are thus saved in the laying-out alone, and much valuable space saved at the same time.

As to the outer fence, a stout paling, with wire netting attached, is all that is needed to keep out cattle and rabbits.

Size and Stocking.—The size depends on the stock required. The planting wants of estates vary, and no cut-and-dried dimensions of the nursery can be fixed. Its size, and the number of trees in it, must depend on the output to the woods annually or periodically. The two should correspond, and an estimate of both may be easily made out when

the owner or his agents have decided how much planting is to be done. In all cases the most expensive trees to buy and the most difficult to raise should have the preference in the estate nursery. If the home stock has to be supplemented from a public nursery, hardwoods or deciduous trees should be the kinds bought, and larch and firs raised at home.

The following rule may serve as a guide, to some extent, in adapting the nursery stock to the planting demands. First of all, the kinds of trees and proportions of each to be planted for timber crops on the estate should be decided. These, we shall suppose, shall consist in the main of larch, Douglas fir, Corsican fir, Scots fir, spruce, oak, ash, and sycamore. Supposing, further, that a plantation one acre in extent has to be

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planted annually at the rate of from 3,000 to 5,000 trees to the acre, according to species and elevation, a stock of these of at least 12,000 or 15,000 would be required in the nursery, in three or four stages, from seedlings up to the planting-out stage. Assuming that 5,000 of that number have to go out in spring or autumn, there should be a proportionate number of one-year seedlings to 'tail on' at the other and younger end. Circumstances may alter cases, but this rule should not be departed from very far, and any intelligent forester should be able, with a little thought, to gauge his wants near enough from year to year according to the number of acres to be planted.

SECTION V

SEEDS OR SEEDLINGS

THIS is a question of considerable importance in the estate nursery. Should the stock of trees be raised from seed or from bought in one- and two-year *untransplanted* cheap seedlings? By seed is the cheapest plan, because, if nurserymen can raise one- and two-year seedlings to sell at from 2s. 6d. to 7s. 6d. per 1,000, the home nurseryman can raise them for half these prices or less, and save much labour in transplanting, and many failures besides. The objection to sowing seed is that, according to general experience at the present time, very few foresters or

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woodmen understand the propagation of forest trees by seed, simple as the work is. When any doubt exists on this point the safest plan is to buy one- and two-year *untransplanted* seedlings. These are the cheapest trees that can be bought, lift with safety, travel in small compass, and transplant easily and successfully. Very few failures should occur in nursery planting at any time if the roots are not carelessly exposed during the operation. A dip of the roots in a puddle of soil of the consistency of treacle, before taking them on to the ground, will generally prevent shrivelling, but the roots should be wet when planted.

SECTION VI

[SOWING FOREST TREE SEEDS—
CONDITIONS

SOWING tree seeds is not difficult work, but getting up a good crop of seedlings depends on certain conditions that should be clearly understood by the woodman. First of all, tree seeds should be tested before sowing. Large seeds may be cut and examined. If they are firm, and have a moist kernel, they will be good as a rule. Fir and other small seeds should, however, be sown in fine soil, in a flower pot, very slightly covered, and put in a warm temperature under glass. The seeds in each test should be

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counted, and note taken of the number which germinate, and these should be the guide as to how thick the crops should be sown. Gardeners usually know how to test seeds.

As to sowing. When forest trees shed their seeds naturally, the seeds germinate freely, although the only covering they have is the decaying vegetable matter on the surface of the ground on which they happen to fall. Where these are sufficient to keep the seeds moist, both large and small seeds germinate, and the reason the seedlings do not often grow up to trees is that they are smothered by weeds during the first two or three years.

In artificial sowing in the nursery nearly all the good seeds ought to grow if the proper conditions are secured. These conditions are three : *first*, a finely broken-up surface soil ; *second*, covering

the seeds with fine soil that they can push through easily, and which should be specially prepared if necessary ; *third*, covering the seeds to the right depth to keep them sufficiently moist till they germinate. Artificial watering is objectionable, as it washes the seeds out and causes the surface of the soil to cake.

There is not so much risk in the case of large seeds, like acorns for example ; but small seeds like those of the larch, Douglas fir, and other conifers, if buried too deeply, may not come up regularly if at all, and if covered in too slightly they may lie for months in the ground, in dry weather, without germinating, and autumn rains may bring them up too late. In a dry sun-baked soil the best of seeds will lie as dormant as if they were still in the seedsman's drawer. And that may happen in a dry spring or summer

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when the seeds are sown at the right depth.

The first condition, then, a fine surface soil, may be secured by winter digging, and allowing the frost to act on the soil, and thoroughly stirring and raking the surface in spring just previous to sowing. On no account should seed be sown when the soil is wet or claggy. It should be in that condition in which gardeners like to sow their onion crop—dry and powdery.

Covering the seeds with a fine soil or compost is the second condition. If the soil of the nursery is inclined to be heavy or lumpy, it may suit the young trees very well after they come up; but such a soil is bad for covering the seed as it cakes, dries, and obstructs the growth of the seedlings. In such a case it is well worth while—in fact it is necessary—to cover the seeds by hand with a prepared

mixture of leaf mould and sand in equal proportions. Both these can usually be easily got. Leaf mould can always be found in woods, and if put through a $\frac{3}{4}$ -inch sieve and added to the sand, and the mixture scattered over the seeds by hand, the seedlings will push through regularly and easily. A few barrow loads of the compost will go a long way, and it is soon put on, especially when the seed is sown in drills. When the soil is fine, light, and sandy, artificial covering is not necessary.

Sowing at the right depth is the third condition. The depth to sow is given in Table I, and is deeper than is usually recommended for some seeds, but not too deep, while sufficient to secure a uniform degree of moisture about the seeds in ordinary weather. To keep the surface of the seed beds sufficiently moist in dry

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weather, and in naturally dry soils, at the sowing depth is difficult, unless means are taken to prevent evaporation from the surface of the beds. Various clumsy devices have been suggested for this purpose, such as mats, branches, &c., but the best plan is to mulch. Gardeners avoid watering seed boxes artificially, but mulch fine, slightly buried seeds, with teased-out moss strewed thinly over the soil; sometimes sheets of paper are used. That plan cannot be adopted in nurseries, but short grass from the lawn mower can usually be had in large quantities on private estates, and that scattered regularly over the beds, thick enough to hide the soil, arrests evaporation effectually, promotes quick germination, is better than artificial watering, and the grass withers away without hurting the seedlings. In fact, several mulchings of this kind may

have to be applied. Where short grass cannot be had, leaf mould from the woods put through a $\frac{3}{4}$ -inch sieve will do as well, and it may be freely scattered over the beds till the soil is quite hidden. Both these materials are easily got and easily applied.

SECTION VII

METHODS OF SOWING

Two methods of nursery sowing are adopted, viz. : in rows and broadcast. We believe sowing in rows, not closer than the distances given in Table I, to be by far the best plan, because the rows allow the push hoe to be used between the rows and expeditious weeding and cleaning ; but chiefly because the space between the rows allows the roots to extend and find sufficient nourishment, which they cannot do in broadcast sown beds, and many seedlings are starved and stunted in consequence. The trees may remain in the seed rows for

two or three years, unless the seed is sown much too thickly, and the biggest trees may be transplanted to the woods direct without any nursery transplanting, a practice becoming much more common than formerly.

Foresters and gardeners know well that when seed beds are sown broadcast the seedlings, when they come up, even moderately thick, and are not soon thinned, die off or come to a standstill in the centre of the bed, while those at the edge of the bed, where the roots find more nourishment, grow much better. The centre becomes starved, the crowded seedlings robbing each other, and soon exhausting all the food within reach. The same thing takes place when forest trees are sown broadcast, and to save the plants, transplanting becomes necessary the first year, and imperative the

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second. When sown in rows, however, the right distance apart, the roots have space and nourishment on both sides, and the trees may be left with safety for two years or even longer, and the strongest may be transplanted from the rows to the wood direct, which saves transplanting in the nursery.

The work of sowing should be carefully done in fine dry weather, between the middle of March and the middle of April, and when the soil is dry ; and all seeds of the fir tribe, or any tree seeds that birds and mice are likely to eat, which include oak, beech, and chestnut, should be thoroughly red-leaded before sowing in the following manner. Put all the seed to be sown in a fine sieve, or piece of coarse muslin cloth, wet the seeds thoroughly, sprinkle a pinch of dry red lead over them (a little goes a long way),

stir well with the hand till the seeds are thickly coated, spread them out to dry on a sheet of paper for an hour or two, restore to the seed bag again, and the seeds are ready for sowing. They will keep for a long period without injury after red-leading, but it is better to sow at once.

Assuming that the season has arrived, and that the ground has been roughly dug in winter, is in the right condition, and that sowing in rows is the method adopted, a level piece of ground should be chosen for the seed beds so that they may not be washed by heavy rains. Next, the ground should be stirred deeply with a steel fork and the beds set out. These may be from 3 to 5 feet wide, according to the species; but, taking the distance between the rows as set out in Table I, allowance must be made for

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an alley 18 inches or 2 feet wide between the beds. This width will allow a 6-inch margin between the outside row and the path up the centre of the alley for weeding and cleaning. Seed beds do not take up much room in any case, and the space between the rows should not be less than that set out in Table I, and more would be advantageous. The alleys should be set out between the beds after the ground has been forked over, and the path up the centre of each alley should be pegged off and trodden down to a line. This done, the beds should then be raked fine so as to have a smooth surface, the rough lumps and stones being raked into the alleys. The shallow furrows for the smaller kinds of seeds should be drawn with a blunt pointed stake or the cross handle of a push hoe. The depth of the furrows

is given in Table I, and the sower should remember that the depth is important and is calculated, not from the level of the thrown-up edge of the furrow, but from the general surface of the seed bed. The furrow may appear to be 2 inches deep, but when levelled down may not cover the seed sufficiently. This work should not be entrusted to anybody but to the head forester or his foreman.

The seed should be sown and covered in as fast as the drills are made, and it should be sown thickly at the rate given in Table I. After covering in, the beds should be lightly raked into the alleys again, but there should be no rolling or patting with the spade after sowing. This is recommended, we are aware, but in most cases it is a bad practice, as it causes the soil, if the least inclined to run together, to cake over the

seeds and obstruct their coming through. Moreover, and as has been advised before, if the soil be heavy and lumpy, covering by hand with a light mixture of sand and leaf mould is the best plan. This compost, if dry and got ready beforehand, should be carried in a basket and scattered in the furrows to the required depth. One man may cover in hundreds of yards of rows in a very short time, and the plan is well worth adopting in all cases. A fine compost of sand and leaf mould never cakes or sets, and all kinds of seeds come up most successfully under such a covering. After sowing, the mulching of short grass or leaf mould, before mentioned, should be put on in sufficient quantity to hide the surface of the bed, and repeated when necessary.

The above directions, in conjunction with those in Table I, apply to nearly

all forest tree seeds, which are not easily stored, and that are apt to heat and germinate prematurely. Large seeds, like the acorn and beech, are best sown as soon as gathered; but mice and pheasants play havoc with them in winter unless well red-leaded. Such seeds as the sycamore, ash, holly, &c., are sometimes mixed with dry sand till spring to rot the husks, but they may almost as well be sown in the furrow at once. The sycamore is very apt to vegetate when stored in sand.

The time taken by tree seeds to sprout after sowing varies, and may range from two to four or six weeks, according to the weather and condition of the soil, but new seed soon comes up if the weather is mild and moist. If the seed consists of new and old samples mixed, the old seed may lie dormant

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much longer; but time should, in any case, be allowed, and there should be no meddling with the seed beds except in careful weeding till the seedlings appear, which, in the case of the ash, may not be for a year or more.

Attention after sowing consists in keeping the beds free from weeds, and here the push hoe comes in usefully and economically, killing the weeds and stirring the surface soil between the rows at the same time. Weeds growing in the rows among the plants must be pulled out by hand, and in so doing care must be taken not to dislodge the seedlings. Women do this work very well if shown how.

Propagation by Layers and Cuttings

The forest trees propagated by layers and cuttings are the elm, poplar, and

willow. Elm seed can be had, but suckers are easily got from old trees, and layers may be had by cutting over-young trees in the nursery to form stools and pegging down layers from these. Willows and poplars are all easily struck from cuttings of two or three old shoots from 2 to 5 feet long, stuck at least a foot into the ground, so that the ends of the cuttings may always be within reach of moisture. A moist but not wet soil suits both species.

SECTION VIII

TRANSPLANTING

THE directions on this head apply to trees whether raised at home or bought in, and the season to plant depends on the species. Larch should be transplanted as soon as the wood is ripe and brown to the tips of the shoots, which will be in November, and what cannot be planted then should be got in in February or March following, or at the latest before the buds begin to swell. Spruces and pines should be transplanted by the middle of November, or in March and April, but the Corsican succeeds best if planted in April. For one-year seed-

lings we prefer spring planting, because the roots are short and the plants are often thrown out of the soil by severe frosts if planted in autumn, and injured or killed, whereas they escape such frosts in spring planting. Two-year-old seedlings have deeper roots and may be transplanted in autumn. The rule, if necessary, should be to move two-year-old seedlings in autumn and one-year in spring. All deciduous trees, like the ash and oak, may be transplanted from November till the middle of March, or while the buds are still dormant. These transplant much more easily than firs and evergreens.

Both one- and two-year seedlings have long roots compared to their tops, and in transplanting the roots should be shortened, but not too severely, by

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cutting off the tap root or the extremities if there are several terminal roots.

Digging and planting should go on together, and there is no need to have either walks or alleys except between the quarters of different species. An opening should be taken out at one end of the quarter, and row should follow row till the lot is finished.

The distance between the rows and between the plants in the rows should be according to the species and the size and vigour of the plants, but the following distances will be a near enough guide :

1-year larch, 12 inches between the rows and 8 inches between the plants.

2-year larch, 18 inches between the rows and 6 inches between the plants.

1-year Scots fir, 9 inches between the rows and 8 inches between the plants.

2-year Scots fir, 12 inches between the rows and 6 inches between the plants.

1- and 2-year Corsican, Austrian, and other pines, the same as Scots fir.

1-year Douglas fir, same as larch.

2-year Douglas fir, same as larch.

• 1-year spruce, 9 inches between the rows and 8 inches between the plants.

2-year spruce, 12 inches between the rows and 6 inches between the plants.

1-year oak, ash, sycamore, and other hardwoods of similar rate of growth, 15 inches between the rows and 4 inches between the plants.

2-year oak, ash, sycamore, and other hardwoods of similar rate of growth, 24 inches between the rows and 6 inches between the plants.

The above distances correspond with the growth of the plants as a rule; but oak, ash, and sycamore, &c., may need more room, as they frequently make tall growth the second year under favourable conditions. A good rule is never to allow the rows to meet. When that happens, smothering begins.

Generally speaking, one-year seedlings are all about the same size, and little

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or no sorting is needed ; but the second year and after that, while the trees are in the nursery, the sizes should, in transplanting, be sorted and planted separately. After the second year a marked difference is observable in the size of most species, due apparently, to constitutional vigour, and there are good reasons for supposing that the strongest seedlings will always keep the lead and produce the biggest trees and best crops of timber in the shortest time. Selection, therefore, becomes important.¹

With these preliminary directions, and assuming that the ground is ready and in a similar condition to that recommended for the seed beds, transplanting is conducted as follows. Beginning at the end of the quarter, a strip is dug wide

¹ The Author drew attention to this subject, probably for the first time, in the *Gardener's Chronicle*, 1904. Nurserymen have been in the habit of sorting, but not with the above object.

enough for the first row and *no more*, for the man must not tread on the dug ground nor put his foot in the furrow. On this strip a garden line is stretched tightly and the soil patted, not too heavily, with the spade to firm it for a

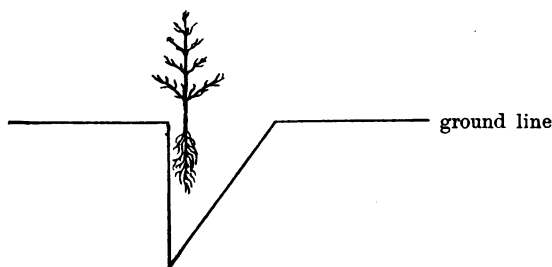


DIAGRAM SHOWING YOUNG TREE IN RIGHT POSITION
IN TRANSPLANTING

cut about 6 inches deep, as shown in the above diagram.

Trees from the seed bed are always of the right root form, and that form should be preserved throughout. The little trench being cut out against the

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line, as here shown, the seedlings should be held, with the roots perpendicular, close to the back of the trench, and have the soil pushed up against them and pressed slightly to fix them, taking care not to bury the collars too deeply. One man goes in advance doing this, and another follows with the spade digging and smoothing up to the row of plants, and so on till the row is finished. If the weather is at all dry the roots should be wetted in a thick soil puddle and *planted while wet*. The rows should also be watered copiously after planting, and if a thin mulching of short grass or rough leaf mould can be scattered between the rows it will be a great advantage in dry weather or in a dry climate. The failures in transplanting seedlings in the nursery should be very few indeed, if the work has been done with ordinary care, for

such trees have always good roots and are in the best condition for moving.

In regard to transplanting generally in the nursery, it cannot be too well understood that every transplanting adds materially to the cost of rearing; hence, between sowing in the nursery and planting out finally in the woods, the first and last stages, there should be as few transplantings as possible. As a rule two should suffice, viz.: transplanting from the seed bed, and one transplanting about two years after that. The third move should be to the woods, when the trees pass out of the nursery stage. More stress is sometimes laid upon transplanting than need be. We have moved the most sensitive of all the firs, the Corsican, from the home nursery to the woods with only one transplanting, and one check by going along the rows of

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three- and four-year-old trees with the spade, inserting it 4 or 5 inches from the row, and giving the roots a hitch up till the roots were *felt* to give, and letting them down again. If this is done effectually in spring it is as good a check as transplanting, and does not cost a tithe of the labour, and there are no failures. The spade cuts or breaks the roots, which push again, and by autumn the trees will lift with a tuft of good roots and transplant successfully. In all cases, while the trees are in the nursery, the straight right root form should be preserved, and when trees come from a public nursery with bent, one-sided, 'walking-stick-handle' roots, they should be rejected. Some good nurserymen have abandoned the one-sided method of planting, but it is still too common.

SECTION IX

HINTS ON PURCHASING TREES

IN buying trees of any planting size from public nurseries always have samples first, and know where the stock are to be seen growing, so that they may, if necessary, be inspected beforehand. Have no second-hand lots unless their source is known.

To know if the trees have been recently transplanted examine the last year's terminal growths on the leaders and side-shoots. If these are long, that is from joint to joint, the trees have not been moved for three or perhaps four years, and will suffer proportionately in

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transplanting, and numbers may die. Trees recently transplanted are always short jointed and stubby in appearance, according to the species, and trees that have not been transplanted are long and lanky.

In ordering, always give ample notice, but limit the time between lifting and delivery, and let it be as short as possible, as the trees suffer when out of the ground, and failures often result from neglect on that point.

Stipulate that the trees are to be lifted with good roots, and that the roots are to be straight, and, if practicable, have the trees lifted under the supervision of the forester or agent employed by the purchaser.

SECTION X

GENERAL MANAGEMENT

GOOD general management consists in arranging the work of the nursery on a methodical plan, keeping the stock of trees up to the mark, according to the planting demands of the estate, and getting them out of the nursery with regularity as soon as they reach the final planting stage, so as to have no accumulations of tall old stock left on hand. Two feet or $2\frac{1}{2}$ feet should be the maximum height of hardwoods and deciduous trees, and firs from 15 to 18 inches high are quite tall enough for planting purposes, and may be got out to the woods

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even less than that, where the natural herbage is not too rank.

Other work consists in keeping the nursery clean and in general good order, but the forester should not be expected to keep it as trim as a flower garden, as it is sometimes unreasonably expected to be kept by the owners. Propagating a stock of trees and rearing them to the final planting-out stage successfully is what an estate nursery is for, and that can be accomplished without any great amount of trimming and cleaning. In summer, keeping down rough weeds likely to interfere with the young trees is the principal work, and may be done by the hoe and the hand; but there should be no raking between the rows. There should be no vacant ground; but when there is any, it should be rough dug in

autumn so as to be ready for the next planting.

The forester will find it a good plan to have a space close by, where he can accumulate a good heap of rough leaf mould and other vegetable and turfy composts for use, and these may always be applied freely to planting quarters as a manure, especially on heavy and light soils.

Arrangements should be made for transplanting seedling and older stock in October, and onwards from that time, and particularly in March and April. If any of the commoner tree seeds have to be collected at home, the trees with good crops should be looked out, and the seeds collected and stored till wanted in cool, dry quarters protected from frost. Acorns, ash, and sycamore seeds are the

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kinds that can be procured most readily, but in the case of other seeds probably the seed can be bought as cheaply as it can be collected, if not cheaper.

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TREE SEEDS

True to name, and of the highest germinating power, are supplied by the Country Gentlemen's Association at the following prices:—

Douglas Fir	...	...	...	...	30/-	per lb.
Japanese Larch	...	...	...	...	15/-	" "
Common Larch	...	...	...	...	2/6	" "
Scots Fir	...	...	...	...	3/6	" "
Corsican Fir	...	...	...	...	4/-	" "
Austrian Fir	...	...	...	...	6/6	" "
Maritime Pine...	...	...	...	...	1/-	" "
Silver Fir	...	...	...	...	2/-	" "
Norway Spruce	...	...	...	...	1/3	" "
Weymouth Pine	...	...	...	...	10/6	" "
Sycamore	...	...	...	...	8d.	" "
Ash	...	...	...	...	6d.	" "
Common Alder	...	...	...	...	9d.	" "
Birch	...	...	...	...	4d.	" "

See page 15 for the approximate germination, the number of seeds per lb., and the quantity to sow.

QUOTATIONS FOR OTHER SEEDS WILL BE FORWARDED
ON APPLICATION.

10 PER CENT. DISCOUNT to MEMBERS of the 'C.G.A.'
Carriage Paid.

THE COUNTRY GENTLEMEN'S ASSOCIATION,

('C.G.A.') Trading Department,

LTD.,

2 Waterloo Place, Pall Mall, LONDON, S.W.

